IES
Newsletter

Volume 4, Number 5
September - October 1987

At the Arboretum ...

This summer the Cary Pines Trail was extended. The new loop trail winds through a lovely hemlock forest overlooking the East Branch of the Wappinger Creek.

[Ed. note: Due to storm damage, Arboretum trails are temporarily closed.]

Sign up now for special landscape design workshops.

Sunday Ecology Programs are held on the first and third Sunday of each month (except holiday weekends).

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See the Fall Calendar on the last page of this Newsletter for information on all of our current public programs.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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Cary Summer Fellowship: Plant Invasion of Old Fields

When a field is abandoned -- no longer needed for crops or as pasture -- it will be invaded by woody plants. This replacement of herbaceous plants by shrubs and trees happens at different speeds in different parts of a field. Succession -- one of the most important processes in ecology -- is the way in which this woody invasion occurs. Dr. Juan Armesto was awarded a 1987 Cary Summer Fellowship to study the process of succession in collaboration with IES Plant Ecologist Dr. Steward Pickett.

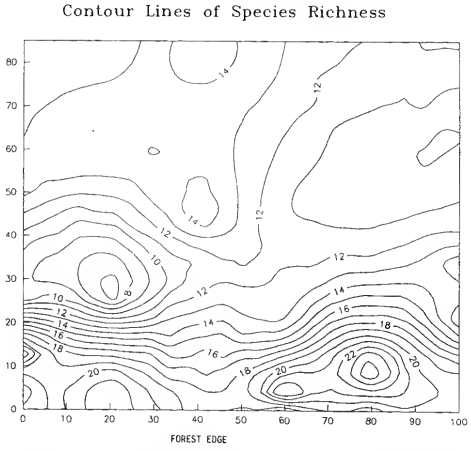
SHARI LIFSON

Dr. Armesto is a professor of botany and plant ecology at the University of Chile in Santiago. His research into the dynamics of plant communities usually takes him to the temperate rain forests of Chiloé, a mountainous island off the southern coast of Chile where the climate is much like that of the U.S. Pacific Northwest. There he looks at the changing forest structure -- more advanced stages of succession -- to understand the dynamics of a forest. The data from his observations are useful in making predictions of how forests develop and change, and these predictions in turn help managers and the public understand how forests can be utilized without being destroyed forever.

Dr. Armesto received his Ph.D. at Rutgers University, where he began to study the process of woody species invasion into abandoned agricultural fields. His research colleagues were Dr. Pickett and Dr. Mark McDonnell, a terrestrial ecologist at IES. The Cary Summer Fellowship provided an exciting opportunity to examine different aspects of the invasion process using existing information on the history of Arboretum oldfields. For three months this summer Dr. Armesto devoted his time to studying the upland fields near the Greenhouse. He was concerned with the question of what factors might influence the spatial distribution of "hot spots" for plant invasion in those fields.

To learn the answer to that question he set up plots within two areas, one a recently abandoned hay field (mowed until 1982) and the other a former pasture abandoned since the late 1930's. In each area he put transect lines from reference features, such as the edge of the woods, to the middle of the field, and randomly selected 0.5m x 2.0m sampling plots along those lines. Wearing a long-sleeved shirt and gloves to ward off poison ivy, brambles and similar hazards, he counted the number of species in each plot. (Much to the surprise of any casual observer, a total of 65 different species of higher plants was found in the research plots of what appeared to be a homogeneous hay field!)

Dr. Armesto also calculated the area of ground cover in each research plot, listed the species, and ranked them by abundance. The information on the number of species per plot (i.e. the species richness) was used to generate a map of the hay field on a computer. The result, below, looks like a topographic map, and shows the distribution of species richness in the field as contour lines which connect points with the same richness. More species were found in areas of the field that were close to the wood's edge, indicating that this edge is a major feature affecting species invasion.



Number of plant species in a recently abandoned hay field, illustrated by contour lines. Figures on the sides are distance in meters.

Data from the field abandoned in the 1930's showed two influences on the process of succession there. One was 'the forest edge effect', as described in the preceding paragraph. This resulted in rapid establishment of woody patches due to seed dispersal and root sprouting from

continued on page 4

Autumn's Strategy: Senescence and Abscision

by Kerry Bauman, Summer Project Assistant

The season is turning: a hint of coolness, shadows stretch long in the late afternoon, sky darkening earlier each night. These subtle, almost imperceptible changes are sufficient to spur a myriad of alterations and activities in preparation for winter. Perhaps the most conspicuous of these alterations in mixed-deciduous forests of the Northeast is autumnal leaf-fall. This process involves leaf senescence and abscision.

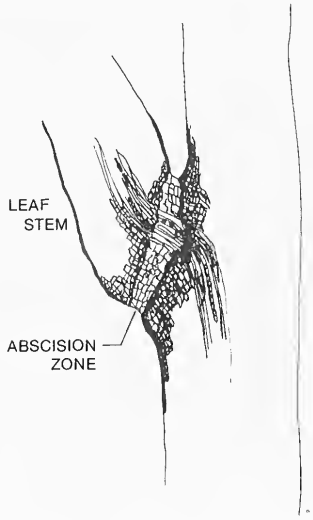
The term abscision is derived from the Latin and means, literally, to separate a member from the whole using an external force. While abscission in plants is considered an internal, physiological action of the plant, the surrounding environment is involved. Shorter day lengths and lower temperatures affect the relative balances of chemicals within a leaf. These alterations initiate processes that cause senescence (aging) and, ultimately, abscision.

The most visible symptom of leaf senescence is changing leaf color. A healthy leaf contains several kinds of pigments that are essential for photosynthesis, the process by which plants use light energy to convert carbon dioxide and water into carbohydrates. Chlorophylls a and b are two of these pigments, as are carotenoids and anthocyanins. Each pigment absorbs light of particular wavelengths in the visible spectrum, and reflects those wavelengths of light which it cannot absorb. It is this reflected light that we see as color.

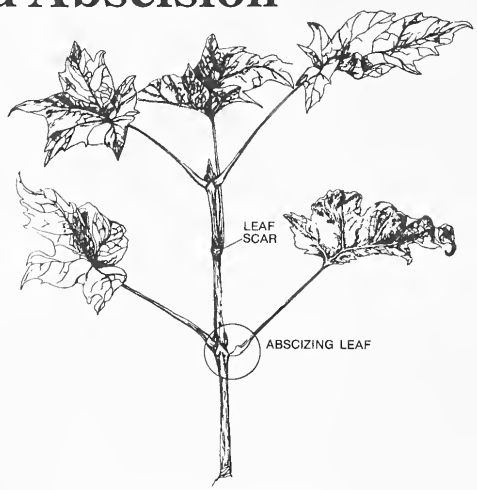
Healthy leaves appear green because they have an abundance of chlorophyll. Chlorophyll absorbs violet, blue, orange, and red wavelengths of light, and reflects green and yellow wavelengths. During senescence, chlorophyll production decreases dramatically, while the normal breakdown, or catabolism, of chlorophyll does not decrease. Thus there is a net loss of chlorophyll from the senescing leaf. In the absence of chlorophyll, other pigments become visible. It is the yellows and oranges reflected by carotenoids and reds reflected by anthocyanins that we recognize in the brilliant foliage of deciduous trees in autumn.

One of the important functions of senescence is the mobilization of materials within a leaf. Some of the catabolites, breakdown products which are primarily nutrients, are transported from the senescing leaf to areas of the plant where they are needed or stored. Nutrients that remain in the leaf when it falls are not all lost, either. Some are liberated to the soil during leaf decomposition and can be taken up, with water, by the plant's roots. In this way, senescence and abscision enable a plant to effectively "recycle" available nutrients.

The abscision zone of a leaf is an area of undifferentiated cells typically located at the point where a leaf's stem joins the branch. In a healthy leaf these cells appear to be in a state of arrested development ... they have weaker cell walls and lack many of the specialized components of regular plant cells. When the leaf begins to senesce, chemical changes occur which cause cells of the abscision zone to differentiate, resulting in leaf abscision.



The mechanism of leaf abscision varies between plant species, but a generalized version can be described. The actual physiological processes of separation occur in a narrow band of cells within the abscision zone, called the separation layer. A thin membrane, called the middle lamella, cements adjoining cells together. During abscision the cells of the separation layer secrete enzymes that cause the middle lamella to swell, weaken, and eventually disintegrate, leaving adjacent cells free. Protective cells grow next to the separation layer; quick development of this leaf scar is beneficial to the plant because it prevents invasion by insects and disease-causing organisms.



In some plant species, instead of separation occurring as a result of the dissolution of the middle lamella, the cells of the separation layer appear to simply dissolve and the leaf falls. In still others, the cells of the abscision zone become suberized (transformed into cork), cutting off water movement. The leaf then dies and is left to twist in the wind until it breaks off.

Leaf scars on tree branches provide clues to the different processes of abscision. When separation involves a rapid, complete, chemical dissolution of the middle lamella, the resulting scar is smooth in appearance. When separation occurs primarily as a physical breaking away, the scar appears relatively rough.

Why does abscision occur? A plant produces only as many fruits and flowers as can be supported by its leaves, and only as many leaves as can be supported by its roots. In this manner, a plant achieves a homeostasis, or balance, with the resources available in its environment. Numerous factors affect this balance, including temperature extremes, moisture stress (characterized by low soil moisture and low atmospheric humidity), wind, infection by disease or pests, and pollution stress. If the environment changes suddenly, it is to the plant's advantage to change accordingly. Abscising leaves is one means of maintaining homeostasis.

In the seasonal climate of the Northeast, it is advantageous for some plants to drop their leaves when winter brings unfavorable growing conditions. In this way they conserve resources until favorable conditions return in the spring and summer months. The brilliance of a mixed-deciduous forest in autumn is a dramatic manifestation of this abscision strategy.

ILLUSTRATIONS BY LISA H. BANDAZIAN

New Staff

SHARI LIFSON

LAURY ZICARI, research displays coordinator, joined the IES Education Program staff at the beginning of September. She is developing display materials to accompany research demonstrations at the Arboretum, and will be coordinating public education programs related to these demonstrations. Ms. Zicari has a master's degree in forest ecology from the SUNY College of Environmental Science and Forestry at Syracuse. Among her previous accomplishments was the design of an "Eco-Van" for the Environmental Education Outreach Facility at the Schuylkill Nature Center in Philadelphia.

Promotion

SHARI LIFSON

JOHN OLSON has been promoted to senior gardener. Mr. Olson began permanent employment as a gardener at the Mary Flagler Cary Arboretum in January, 1973, and currently works with Manager of Display Gardens Bradley Roeller in grounds maintenance and horticulture.

Summer Staff at the Institute

During the summer months high school and college students are hired to assist on research projects and to work with operations and display garden staff. In addition, graduate students and scientists from other institutions come to our labs to advance their own studies. This summer's staff were:

Top:

Front row (left to right): Karen Souza (horticulture); Beth Schroeder (horticulture); Claes Thelemarck (vegetation dynamics/zooplankton); Diane Borden (opossums/Lyme tick/coyote predation); Eileen Geagan (air pollution effects on white pine)

Second row: Marc Steininger (gypsy moths); Lauren Parmalee (acid rain study ponds); Karl Schoeberl (invertebrates in Tivoli South Bay)

Third row: Paul Ode (interactions on utility rights-of-way); Harold Fraleigh (interactions on utility r-o-w); Rob Hossler (opossums in S.E. New York); Laura Sices (nutrient uptake by pine seedlings); Amanda Hiller (environmental chemistry)

Back row: Helen Cyr (aquatic ecosystems); Kerry Bauman (pollution garden); Steve Baines (dissolved organic matter in lakes); Dave Behrens (operations); Dorothy Ansley (horticulture); Heather Henter (gypsy moths)

Bottom:

Front row: Erik McCarron (algae in Wappinger Creek); Alan Zytowski (operations); Richard Lounsbury (Greenhouse); Geoff Lloyd (interactions on utility r-o-w)

Back row: Judy Koch (interactions on utility r-o-w); Mark Vose (precipitation & soil moisture); Keith Elliot (operations); Hannah Morgan (Business Office); Richard Pouyat (history, ecology of urban natural areas)

Missing from photographs: Juan Armesto (old field structure); Lauren Atherly (Business Office); Matthew Eaton (air pollution effects on white pine); Amie Frind (permanent vegetation plots, NYBG Forest); Jane Gerlach (acid rain study ponds); Alan Goldhammer (fluxes in Tivoli South Bay); William Gonzalez (permanent vegetation plots, NYBG Forest); Jerry Griffin (horticulture); Cheryl Hayashi (nutrient budgets in Mirror Lake, NH); Lars Hedin (organic matter in natural stream ecosystems); Andrea Kirn (interactions on utility r-o-w); Greg Likens (computerization of reprint collection); Leslie Likens (computerization of reprint collection); Karin Limburg (feeding ecology of river herring); Mark Mattson (Mirror Lake sediments); Andrew McLaughlin (trail maintenance, NYBG Forest); Cliff Ochs (bacterial production in Mirror Lake); Chris Peterson (vegetation recovery, Tionesta Natural Area); Cathy Snygg (scenic overlook, NYBG Forest); Richard Spalding (meadow management & trail displays); Sue Tipton (air pollution garden & nature trails); Rachael Warner (horticulture); Kathleen Weathers (cloud water deposition; Todd Webber (vegetation sampling, Tionesta Natural Area); Carl White (mineralization in the NYBG Forest soils)

SHARI LIFSON

Invasion ... *from page 1*

the nearby woods. The second influence was a stone wall separating the area from an adjacent field. Scattered trees were present along this wall at the time that the field was abandoned. Those trees not only produced seeds themselves but also provided perches for fruit-eating birds that dispersed seeds from different plant species into the field. This led to the growth of dense thickets of cedars, dogwoods and sumac along the wall. Other areas in the field, located away from the forest edge and the stone wall, were still dominated by grasses, 50 years after abandonment.

Dr. Armesto is interested in regional comparisions and will use data resulting from this summer's study to compare the effects of land use between the eastern United States, where fields have been used for the past 200 to 300 years, and southern Chile, where fields date from no more than 100 years. In addition, he is leaving his research plots at IES until next year when he hopes that soil tests will provide data on how nutrient levels and other soil characteristics relate to the "hot spots" for species invasion within old fields.

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The Cary Summer Fellowship is an annual award enabling one or more scientists to do research at the Institute. Funds for the award are provided by the Mary Flagler Cary Charitable Trust. Cary Fellows are typically at an early stage in their scientific careers, and the research position at IES gives them the opportunity to pursue intensive, uninterrupted research. Results from these short-term projects contribute to the scientists' long-term teaching and research programs at their home institutions.

Fall Calendar

ADULT EDUCATION PROGRAM

Landscape Design Workshops

Oct. 31st: Landscape Site Plans: Interpretation and Review
Nov. 14th: Landscape Preservation: Ecological and Social Issues

Holiday Workshops

Nov. 7th and 21st: Large Wired Pinecone Wreath
Dec. 5th: Stenciled Tree Skirt
Dec. 5th: Berry Bowl Workshop
Dec. 12th: Williamsburg Centerpiece
Dec. 12th: Holiday Arrangement

For registration information, or to be put on the mailing list for the Adult Education Program catalogue, call the Gifford House at the number below.

SUNDAY ECOLOGY PROGRAMS

Free public programs are offered on the first and third Sunday of each month. All programs are from one to two hours long, and begin at 2:00 pm at the Gifford House unless otherwise noted.

Tentative schedule (please call (914) 677-5358 to confirm the day's topic):

Oct. 18: The secret life of soils (Alan Berkowitz) - Walk
Nov. 1st: Return to the rain forest: Ecuador expedition '87 (Jill Cadwallader) - Talk
Nov. 15th: Air pollution and the forest (Gary Lovett) - Walk
Dec. 6th: Unusual flora and fauna in Australia (Gene Likens) - Talk

For ecology walks, wear long pants and sturdy footwear with socks; long-sleeved shirts or jackets are also recommended. In case of inclement weather, call (914) 677-5358 after 1 pm to learn the status of the day's program.

Ecology talks are slide presentations held indoors at the Gifford House.

RESEARCH DISPLAYS

IES is setting up displays to introduce Arboretum visitors to the methods and thinking behind ongoing ecological research projects. The first of these to be completed is "Acid Rain Study Ponds", behind the Gifford House. Here, tanks simulating natural ponds (complete with plants and animals) are exposed to different chemical treatments and the results recorded twice a week. This free demonstration is open to the public during Arboretum hours through October; children must be accompanied by an adult. An IES staff scientist will give special programs to groups that call the number below for an appointment.

GREENHOUSE

The IES Greenhouse performs double-duty: it is a year-round tropical-plant paradise as well as a site for controlled environmental research. The public is invited to explore both aspects during Arboretum hours. There is no admission fee, but visitors should first stop at the Gifford House for a free permit.

SCIENTIFIC SEMINARS

The Institute's weekly program of scientific seminars features presentations by visiting scientists or Institute staff. All seminars take place in the Plant Science Building on Fridays at 3:30 p.m. Admission is free. For a schedule, contact Julie Morgan at (914) 677-5343.

ART EXHIBIT

"Whispering Spheres", a series of oil paintings by former Poughkeepsie resident Catherine Rutgers Sand, is on display in the lobby of the Plant Science Building. This exhibit is open on weekdays from 8:30 to 4:30 until December 11th (closed on public holidays). Admission is free.

ARBORETUM HOURS

Monday through Saturday, 9 a.m. to 4 p.m.; Sunday, 1 - 4 p.m. The Gift and Plant Shops are open Tuesday through Saturday 11 a.m. to 4 p.m.; Sunday 1 - 4 p.m. Closed on public holidays and during the deer hunting season. All visitors must obtain a free permit at the Gifford House for access to the Arboretum.

MEMBERSHIP

Take out a membership in the Mary Flagler Cary Arboretum. Benefits include a special member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, six issues of the IES Newsletter each year, free subscription to *Garden* (the beautifully illustrated magazine for the enterprising and inquisitive gardener), and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. Individual membership is $25; family membership is $35. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5358 weekdays from 8:30-4:30.

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